

In re application of: George M. Dougherty

Attorney Docket No.: UCALP028

Application No.: 09/994,280

Examiner: Renzo Rocchegiani

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Group: 2825

Title: THIN FILM MEMBRANE STRUCTURE

DECLARATION UNDER 37 CFR § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, George M. Dougherty, declare as follows:

1. I am the inventor of the above-referenced patent application.
2. I have a Doctor of Philosophy degree in Materials Science and Engineering from the University of California at Berkeley, a Master of Science in Materials Science from the University of Virginia, and a Bachelor of Science in Aerospace Engineering from the University of Virginia.
3. I am currently on the staff of the Center for Micro and Nano Technology at Lawrence Livermore National Laboratory in Livermore, California. The above-referenced patent application covers an invention I made while a graduate student researcher at the University of California at Berkeley.
4. At UC Berkeley, from 1997 to 2002, I was a member of the research group of Professor Albert Pisano. Kyle S. Lebouitz, a named inventor on U.S. Patent 5,919,364 (the '364 patent), was a member of the same research group, who graduated shortly after I arrived. Lebouitz described to me the lack of a process for reliably producing a liquid-permeable polycrystalline silicon film (such as called for in the '364 patent) and the desire of the research group to obtain such a process. The film deposition conditions being used at the time (and stated in the '364 patent) were the ones used by M. W. Judy and R. T. Howe (referenced in the above-referenced patent application) during their accidental discovery of silicon film permeability in

1993. Leboutitz described the very poor success rate of this recipe, and other members of the research group described to me their unsuccessful attempts to produce permeable films using the same recipe. As there was also no scientific understanding of the cause of the film permeability, I undertook a materials science study of permeability in silicon films as part of my dissertation research.

5. These studies resulted in the invention that is the subject of the above-referenced patent application. As described in detail in the above-referenced application, it was discovered that permeability can occur as a result of a highly unusual grain structure that occurs only in silicon films that are grown with residual stress very close to zero. This anomalous grain structure was discovered as a result of my research. The essence of the invention is to tightly control the residual stress so as to induce this grain structure.

6. The tight control of residual stress is a key aspect of the invention. Leboutitz did not control or measure the residual stress of his films, and no mention of residual stress appears in the '364 patent or any other publication by Leboutitz.

7. The anomalous, and distinctive, grain structure is the other key aspect of the invention. Neither the '364 patent nor any other publication by Leboutitz describes this grain structure or the relationship of film porosity to the grain structure.

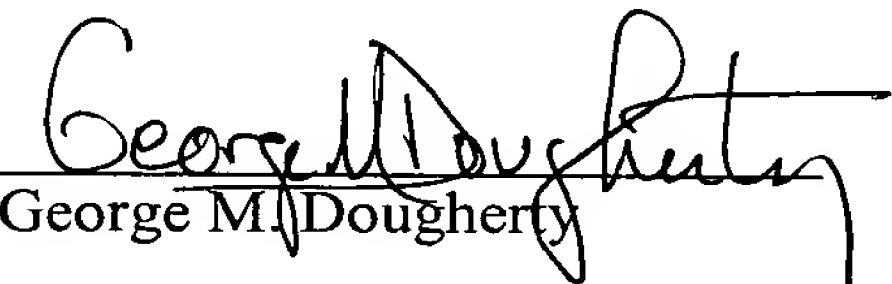
8. The relationship between grain structure and residual stress in thin films is very complex and varies greatly with the material and the deposition process. Residual stress is a product of many variables, and is not a factor that is directly controlled during most thin film deposition processes. It certainly was not controlled by Leboutitz in growing his silicon film. At the time of my invention, there was nothing in the art, at least as far as I am aware, to predict that an anomalous grain structure, resulting in a porous silicon film, could occur as a result of very low residual stress. Such a phenomenon had not been observed in other materials, or in silicon despite decades of research on thin film silicon deposition.

9. No film residual stress measurements were taken by Leboutitz, and no characterization studies performed on the films he produced (or those produced by M. W. Judy and R. T. Howe) have shown evidence of the distinctive grain structure associated with porous films made using the recently defined process. It is therefore

not possible to determine whether the permeable films produced by the earlier researchers resembled those produced by the new process, or were the result of a different phenomenon.

10. Since the invention of this new process, it has become a standard means of producing porous films, and has been used to reliably produce porous silicon films by researchers at UC Berkeley, other universities and private companies.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both (under Section 1001 of Title 18 of the United States Code), and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.


George M. Dougherty

5 December 2003
Date